

## **Re-contextualising TPACK: exploring teachers' (non)use of digital technologies**

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## **Re-contextualising TPACK: exploring teachers' (non)use of digital technologies**

Technological, pedagogical and content knowledge (TPACK) has been used by hundreds of studies as a theoretical framework to explore teachers' technology use in classroom settings. While these studies have contributed to understandings of the interplay between these different knowledge domains and the differences between pre- and in-service teachers' knowledge, little work has been done to examine the influence of teachers' socially mediated workplace settings on TPACK enactment. This paper begins to address this issue reporting findings from an eight month case study involving ten teachers in an Australian secondary school. Results reported in this paper indicate that TPACK enactment is influenced by processes of identity development and practice. These findings challenge the established position of knowledge as an epistemological possession inherent in the TPACK framework rather than also considering knowing as an epistemology of practice. Implications for in-service teachers and school authorities are discussed and suggestions for future research considered.

**Keywords:** TPACK; Communities of Practice; situated learning

### **Introduction**

Teachers' use of digital technology in classroom settings has been an area of academic investigation for several decades (for example, see: Mumtaz, 2000; Selwyn, 2010b).

Use of technologies is characterised by complex, contradicting and changing interdependencies between technological, pedagogical and content demands that are mediated by the situated social contexts that bound teachers' practice (Archambault & Crippen, 2009; Cox, 2008; Mishra & Koehler, 2006; Mumtaz, 2000; Shulman, 1986; Somekh, 2008; Straub, 2009). Research investigating this multifarious problem, often using adoption-diffusion models as a basis, reports that technology integration is not happening, is happening too slowly or happening with little or no effect on student's

learning (for example, see: Cuban, 2004; Dynarski et al., 2007; Howley, Wood, & Hough, 2011; Selwyn, 2010a).

The complexity of this “wicked problem” (Rittel & Webber, 1973) and the varying results reported by research suggests that adoption-diffusion models do not adequately address the complexity of teachers’ pedagogical uses of digital technologies. More recently, teachers’ use of digital technologies has been examined through the technological, pedagogical and content knowledge (TPACK) framework (Mishra & Koehler, 2006). While TPACK has been often used as a framework to measure teachers’ knowledge and to explain teachers use and non-use of digital technologies, little attention had been paid to the socio-cultural processes that shape in-service teachers’ TPACK enactment (Phillips, 2013).

#### **TPACK as a theoretical framework to understand teachers’ (non) use of digital technologies.**

The TPACK framework builds on Shulman’s (1986) delineation of teachers’ professional knowledge as pedagogical content knowledge (PCK). The PCK framework differentiated teachers from content experts as expert teachers have a balanced blend of pedagogical knowledge (PK) and content knowledge (CK) collectively labelled pedagogical content knowledge (PCK) in contrast to content experts’ deference to CK.

More recently, Koehler and Mishra (2005) re-considered Shulman’s PCK framework in an attempt to understand how the increasing use of digital technologies in schools might impact on the development of teachers professional knowledge. In doing so Mishra and Koehler (2006) expanded the PCK framework through the addition of technological knowledge (TK). Mishra and Koehler (2006) proposed that good teaching with technology involves a balanced combination of technological, pedagogical and content knowledge or TPACK. Mishra and Koehler (2006) represented their TPACK

framework as three overlapping circles, with each circle representing a component of teachers' professional knowledge. This framework resulted in seven potential forms of teachers' professional knowledge with the aspirational TPACK positioned at the nexus of these circles. Bounding these different forms of knowledge is the context in which teachers' acquire and exhibit their knowledge as shown in Figure 1.

PLEASE PLACE FIGURE 1 HERE

The impact of the TPACK model has been profound and has been used in hundreds of studies examining teachers' professional knowledge (Graham, 2011), with the majority of these using surveys to measure the extent of teachers' TPACK (Jordan & Dinh, 2012). With such a proliferation of TPACK based research, it comes as little surprise that there is marked variation in the contexts in which investigations have examined TPACK and include international examinations of the TPACK development of pre-service teachers ~~(for example, see: Albion, Jamieson Proctor, & Finger, 2010)~~ (for example, see: Agyei & Keengwe, 2014), distance educators (for example, see: Archambault & Crippen, 2009) and primary teachers ~~(for example, see: Chai, Ling Koh, Tsai, & Lee Wee Tan, 2011)~~ (Chai & Tsai, 2013). In Australia the most recent, large-scale use of TPACK was in the nationally funded Teaching Teachers for the Future (TTF) project. While these investigations have made valuable contributions to our understanding of the interplay between forms of professional knowledge in a variety of settings, in-service teachers' TPACK acquisition in their workplaces remains an under-explored context (for example, see: Jordan & Dinh, 2012).

### ***TPACK and context***

One reason why TPACK acquisition and development (and PCK before it) has proven so difficult to measure is that knowledge must be acquired and exhibited in a

specific context. Mishra and Koehler (2006) acknowledged the influence of context on teachers' TPACK enactment stating:

The core of our argument is that there is no single technological solution that applies for every teacher, every course, or every view of teaching. Quality teaching requires developing a nuanced understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations. (Mishra & Koehler, 2006, p. 1029)

The importance of context was also discussed by Cox (2008) who concluded that “the effect of context is that TP[A]CK is unique, temporary, situated, idiosyncratic, adaptive, and specific and will be different for each teacher in each situation” (p.47) therefore suggesting that “any true example of TP[A]CK must necessarily include the context of that example” (p.48). Despite Cox's (2008) indication of the importance of context, her extensive literature review revealed that much of the published research examining TPACK focused on measuring or defining forms of knowledge that are part of the TPACK framework and paid less attention to the context in which the TPACK is developed or enacted. The lack of attention placed on context is reflected in Cox's (2008) claim that while “an example of TPACK generally also contains an explanation of the context in which it took place, some of these examples are real and others are invented by the authors” (p.51). To position context as more significant, Cox's (2008) contribution in clearly delineating aspects of the TPACK framework utilises Kelly's (2008) conceptualisation of context:

Included in the idea of context are such things as the school environment, the physical features of the classroom, the availability of technology, the demographic characteristics of students and teachers including prior experience with technology, the particular topic being taught, the preferred instructional methods of the teacher, etc. (Kelly, 2008 as cited in Cox, 2008, p. 47)

Kelly (2008) and Cox's (2008) expression of context as a location in which TPACK is enacted provides one way in which context could be interpreted; however, consideration of context in this manner has been criticised by more recent investigations such as the work done by Porras-Hernández and Salinas-Amescua (2013) who contribute one of the few examples of research that utilises a different understanding of context, providing an example of TPACK construction in a Latin American socio-cultural context. In addition to making a contribution to understandings of Latin American socio-cultural contexts, Porras-Hernández and Salinas-Amescua (2013) advocate for different understandings of context in the TPACK framework claiming that "the original TPACK framework is limited in that it defines the contexts in which teachers work too narrowly. In fact, the majority of published work refers to the context element in a rather general manner" (p.224).

A challenge facing researchers examining teachers' pedagogical technology choices is the selection of a framework through which teachers' acquisition, development and enactment of TPACK can be examined and analysed given the situated nature of teachers' practice. This study builds on previous literature that has argued for the suitability of Wenger's (1998) Communities of Practice (CoP) as a situated learning framework to learning to explore the socio-cultural influences on teachers' pedagogical technology practices and identity transformations (Phillips, 2013). In particular, this paper draws on Wenger's (1998) notions of mutual engagement and identity outlined by Phillips (2013) as socially mediated processes that shape in-service teachers' TPACK enactment.

## **Method**

This paper reports on one case study developed as part of a larger, eight month case study investigation which generated cases of four teachers. While each of these cases

provided insights into the ways in which teachers enacted their TPACK (Phillips, 2014).  
Anna's case reported in this paper highlights the importance of the theoretical  
connection between identity, practice and knowledge enactment (behaviour) from a CoP  
perspective.

Anna and her colleagues were recruited from one co-educational government secondary school in Melbourne, Australia. In contrast to most schools run by the Victorian State Government, Drake Secondary College was a select entry school for students in Year 10 - 12 and promotes the pursuit of academic excellence in Science, Mathematics and associated technologies.

Examining the ways in which these teachers enacted their TPACK, the study drew on data generated from ethnographic observations and semi-structured interviews with the participants as well as from colleagues' who had been invited by the teachers to participate in the study as their key professional learning colleagues. In total, ten participants contributed to the four cases investigated in this study, however, this paper will draw on data from the participants detailed in Table 1, particularly focussing on the ways in which mutual engagement and identity shape Anna's TPACK enactment.

PLEASE PLACE TABLE 1 HERE

This research purposely did not consider how participants' behaviour, or the processes described by Wenger's (1998) CoP framework, may be explained by other theories. This research did not aim to validate Wenger's (1998) CoP as a theory, but rather investigate if, from this theoretical perspective, themes and processes can be identified that help explain in-service teachers' TPACK enactment. Consequently, the observed and reported enactment of TPACK in this investigation could be recast as examinations of power-relations, culture, gender differences, socioeconomic class or any other socio-cultural phenomenon, as these mediate the enactment of particular

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knowledge forms. However, it has been a deliberate choice not to do this and to address these issues to the extent that they emerge as significant themes which help to clarify the role of CoP. Indeed, “CoP as a social theory of situated learning is compatible with these socio-cultural influences in the way it considers them as personal histories and trajectories of identity” (Henderson, 2007, p. 5).

### **Analysis and discussion**

The remainder of this paper analyses data from Anna’s case with the aim of developing an understanding of how socially mediated processes of participation, particularly mutual engagement, and identity as described in Wenger’s (1998) CoP framework shape her TPACK enactment. In addition to Anna’s perspective, use of the CoP framework as a lens through which in-service teachers’ TPACK enactment can be explored necessitates identity to be considered as a socially mediated phenomenon. Wenger (1998) argues “we define who we are by the ways we experience our selves through participation as well as by the ways we and others reify our selves” (p.149). In Anna’s case, her perceptions of her identity, practice and TPACK will be compared with perceptions of Anna’s TPACK expressed by her two key professional learning colleagues, Jake and John. In addition to the insights into Anna’s current TPACK and future ambitions, this analysis will also reveal how multiple perspectives of an individual’s TPACK can lead to a more detailed understanding of their TPACK strengths and weaknesses that are enacted in different contexts.

### ***Introducing Anna***

Anna’s past participation in a variety of CoP has shaped her identity as an old-timer. She is an experienced teacher and administrator having taught for three years in Eastern Europe and for nine years in Australia, the last two at Drake Secondary College. In



addition to her teaching roles, Anna has held Daily Organiser, Timetabler and Director of Reporting positions in a variety of other schools. Wenger (1998) contends that identity cannot be considered as static but instead a “constant becoming” (p.154). Developing his argument for this perspective, Wenger (1998) asserts that our identities are constantly changing, moving in trajectories that “incorporate the past and future in the very process of negotiating the present” (p.155). As such, Wenger (1998) argues that “the work of identity is always going on” (p.154) as we identify ourselves as much by where we have come from and where we believe we are going as by our current competence as members of a CoP. The following section will discuss Anna’s identity and trajectory within her CoP at Drake Secondary College.

One of her current roles requires her to start her work early each day as her first task after arriving at Drake Secondary College is to put in place a number of arrangements for the day ahead. Known in schools as a Daily Organiser, Anna is the individual that other teachers contact if they are going to be away from school for any reason. Daily Organisers are often responding to last minute telephone calls or emails from teachers who have become unwell, have to care for a sick family member or whose car has broken down on the freeway on the way to work. Finding last minute replacements to ‘cover’ classes left by absent teachers requires the ability to not only work effectively with technology to disseminate required information in a timely manner but also involves careful balancing and monitoring to ensure that the extra workload covering classes is shared equitably by all teachers in the school.

Understanding the subtle implications of these types of decisions requires knowledge of the ways in which teachers work within schools, irrespective of subject community differences. For example, an effective Daily Organiser who may not be a member of the Science Teachers CoP understands the problems associated with

allocating extras (additional teaching to cover classes left by absent teachers) to teachers of senior Science classes in late May as they prepare students for important, externally assessed mid-year examinations. John, the Deputy Head of Mathematics, confirmed Anna's strong administrative knowledge base and competence in her administrative role stating that Anna was "very, very organised and understands the different pressures we are all under" and that she "knows how to get the job done" (John, Interview 30/10/2012).

Notwithstanding Anna's competent participation in this aspect of her work, she indicated that the knowledge and practices associated with her administrative role were often "too boring for me and time passes very slowly" (Anna, Interview 23/2/12). Despite demonstrating competence through practices developed through her previous experiences working in a number of administrative positions within schools, Anna was not seeking to strengthen this aspect of her identity by pursuing a trajectory that would see her completing more of the organisational tasks she finds onerous.

In contrast, Anna privileges her identity as a Mathematics teacher where she feels most useful over her administrative role where "time passes very slowly" (Anna, Interview 23/2/12). Anna stated on three occasions throughout the data collection phase of this research that she was not seeking to take on any additional administrative responsibilities and explained that she felt she "is most useful when [she] is in the classroom" (Anna, Interview 6/9/12). Anna's affinity with classroom practices and knowledge was confirmed by Jake who felt that "she just couldn't hack an office job because [she] needs that contact with students", "she's got good all-round [classroom] knowledge" and "I learn so much from working with her because she is such a great teacher" (Jake, Interview 22/11/2012). Jake's opinion carries weight in this case as he is not only a member of the Mathematics Teachers' CoP but, more particularly, he is

Anna's team teaching partner sharing the teaching of five classes with her. Anna also nominated Jake as a key professional learning colleague for this project. He is therefore in a unique position to observe and comment on her capacities as a classroom teacher. While Anna participates as a member of the CoP at Drake Secondary College in a different role, her comments along with Jake's perspective reveal a preference for participation and identification as classroom teacher rather than as an administrator. It is in this role that Anna feels "most useful" (Anna, Interview 6/9/12) and this perspective is shared by others, for example Jake's claim that "she is such a great teacher" (Jake, Interview 22/11/2012). Despite Anna's preference to participate as a classroom teacher, there is part of her identity through which she is perceived as a competent administrator as seen in John's belief that as a Daily Organiser Anna "knows how to get the job done" (John, Interview 30/10/2012).

These two different trajectories therefore contribute to Anna's identity at Drake Secondary College. From a CoP perspective "there is a profound connection between identity and practice" (Wenger, 1998, p. 149) and this connection between identity and practice can help explain why individuals such as Anna "often behave rather differently in each [context], construct different aspects of ourselves, and gain different perspectives" (Wenger, 1998, p. 159). The differences in Anna's practices and identity when participating as an administrator or as a classroom teacher also draw on different forms of Anna's knowledge as "every practice is in some sense a form of knowledge, and knowing is participating in that practice" (Wenger, 1998, p. 141). Wenger (1998) therefore makes a connection between identity, practice and knowledge enactment (behaviour) that helps explain differences in behaviour exhibited in different contexts.

### *Exploring Anna's current TPACK from three perspectives*

#### *Anna's perspective*

To elucidate Anna's beliefs about her own TPACK I concluded my final interview with Anna by describing the TPACK model to her in some detail, explaining the different knowledge components and their overlaps as defined by Cox (2008), as well as showing her a printed copy of the TPACK diagram shown in Figure 1. With this understanding of the TPACK framework, I asked Anna to identify where she felt her knowledge would be best located. After looking at the TPACK framework depicted on an A4 page in front of her for approximately 30 seconds, Anna replied "I'm not in the middle because I am still missing some of the technological knowledge. So that will be my aim to be here" (Anna, Interview 6/9/12) pointing to the TPACK nexus.

While acknowledging the importance of Anna's future aspirations, I also asked her to indicate where she thought her current knowledge would best be represented on the TPACK diagram in front of her. Anna replied:

I think I am actually using technology for pedagogical knowledge, but I need more [pausing and pointing to TPK] ... I don't have problem with this one [marking PCK on the TPACK diagram]. But I think that for now, I'm lacking the technological knowledge in this area [pointing to TPK], because I would like to start developing some more things in this [marking TPK] area. (Anna, Interview 6/9/12)

Anna concluded her reply marking a point at the upper end of the PCK section of the TPACK diagram as shown in Figure 2 indicating her belief about the best location for her current TPACK.

PLEASE PLACE FIGURE 2 HERE

Anna's comments are valuable for this investigation for two reasons. First, understanding Anna's desire to be identified and participate as a classroom teacher rather than as an administrator Anna's established earlier in the paper and her espoused desire to have balanced TPACK, "that is my aim to be here [TPACK]" (Anna, Interview 6/9/12), reinforces the inherent tenet underpinning the TPACK framework that a balance of technological, pedagogical and content knowledge is required for effective teaching with technology.

Second, Anna's espoused desire to have a balanced TPACK coupled with her preference to participate and be identified as a classroom teacher provides an example of Wenger's (1998) theoretical connection between knowledge, practice and identity. However, Anna's comments also reveal a different way of conceptualising TPACK: as future, desired knowledge that might support an imagined trajectory and identity.

Anna's identification of her lower TK, that she was "still missing some of the technological knowledge" and her desire to "start developing some more things in this [marking the TPK] area" (Anna, Interview 6/9/12) illustrates that Anna was not only considering TPACK as knowledge that she had already formed and complete but that Anna also considered TPACK as knowledge in development. Moreover, Anna's reply when asked to indicate where Anna thought her current knowledge would best be represented on the TPACK diagram still included references to desired, future competencies, for example: "*I would like to start developing* [emphasis added]" (Anna, Interview 6/9/12).

Wenger (1998) regards trajectory is an important part of identity development that is not "a fixed course or a fixed destination ... [nor] a path that can be foreseen or charted but a continuous motion" (p.154). Anna's case provides an example of this continuous motion. Anna's previous participation established her competent identity as

both an administrator and classroom teacher. Her current participation and identification as an administrator sits in contrast to her preferred form of participation and identification as a classroom teacher. Furthermore, it is Anna's anticipated identity development as a competent classroom teacher that appears to influence Anna's anticipated TPK development.

Discussing Anna's TPACK not only showed her beliefs about her current TPACK but also revealed her imagined future trajectory and her desire to participate and be identified as a classroom teacher. Anna's comments indicate that to pursue this trajectory she feels as though she needs to develop her TK to achieve TPACK. Anna's espoused desire to enhance her TK provides a lived example of the way the CoP framework, in particular an imagined future trajectory, may influence an in-service teacher's TPACK enactment and thereby provide an example of how learning comes about through participation.

#### *Jake's perspective*

As highlighted previously, use of the CoP framework as a lens through which in-service teachers' TPACK enactment can be explored necessitates identity to be considered as a socially mediated phenomenon. Wenger (1998) argues "we define who we are by the ways we experience our selves through participation as well as by the ways we and others reify our selves" (p.149). In Anna's case, we are able to compare her perceptions of her participation, identity and TPACK with those expressed by her two key professional learning colleagues, Jake and John, thereby gaining a range of perspectives about Anna's TPACK.

In a similar manner to the way the TPACK framework was explained and shown to Anna, both Jake and John were asked to discuss Anna's TPACK. In contrast to Anna's self-reported TPACK position in which she identifies her TK as being

comparatively weak in comparison to her PCK, both Anna's key professional learning colleagues held a different perspective.

When looking at the TPACK diagram on the A4 piece of paper in front of him, Jake, Anna's team teaching partner for five classes, stated that "all-rounder is a really good description for her. She's got good pedagogical knowledge, really good knowledge of content and resources, really good ICT use. So she's just that real all-rounder" (Jake, Interview 22/11/2012). When asked to indicate where he would position Anna on the TPACK diagram Jake commented "I think in the middle. Her technological skill set is different from mine, but it's still very strong. I feel she fits genuinely in the middle of this" (Jake, Interview 22/11/2012) marking the TPACK nexus shown on Figure 3.

PLEASE PLACE FIGURE 3 HERE

Jake's indication that Anna has "really good ICT use" suggests that he believes Anna's TK is higher than she believes while his claim that Anna's "technological skill set is different from mine" (Jake, Interview 22/11/2012) provides a distinction between Jake's perception of his own TK and Anna's TK. Jake's belief that Anna is a "real all-rounder" (Jake, Interview 22/11/2012) and has "really good ICT use" (Jake, Interview 22/11/2012) sits in contrast to Anna's belief that her TK, in particular her TPK, is weaker than other parts of her TPACK. In contrast to a singular conceptualisation of TPACK as an epistemology of possession (Cook & Brown, 1999), knowledge developed "inside individual human heads" (Simon, 1991, p. 125), as an individually acquired, aspirational endpoint (Phillips, 2013) or as a static form of knowledge that, once obtained is not lost (cf Cook & Brown, 1999), the contrast between Anna and Jake's perception of Anna's TPACK indicates that maintaining TPACK requires ongoing work and development, particularly in Anna's case of TK.

While Jake believes that Anna's TPACK is balanced, he also recognised that her "technological skill set is different from mine" (Jake, Interview 22/11/2012). When asked to provide examples of these differences, Jake highlighted Anna's extensive "collection of PowerPoint's [from which she] is always able to find one which really summarises key information" (Jake, Interview 22/11/2012). In contrast Jake indicated "I like dynamic sort of geometry software where kids can move things and you can see the effect and hope that the students get more meaning from that than from a static image" (Jake, Interview 22/11/2012). When asked where he developed his pedagogical preference for dynamic software, Jake indicated that his father was "one of the first computer science teachers in the state so I have always seen and been interested in the ways in which teachers use different forms of new technology in their lessons", in particular "the way my father was always looking for ways for his students to make sense of [content] for themselves by using technology" (Jake, Interview 22/11/2012). Jake's digital technology preferences therefore differ from Anna's as he prefers students to be in control of dynamic software from which they can construct meaning at their own pace, in contrast to Anna's teacher focussed use of PowerPoint.

Anna confirmed Jake's belief about her use of PowerPoint presentations explaining "there is not enough space to fit everything that you want to be on one board so they [students] can actually make a [conceptual] connection. With a PowerPoint presentation I can go backwards so they can see the connection" (Anna, Interview 6/9/12). Anna further explained that the ability to be able to go backwards and forwards and show the development of equations and graphs was important and reinforced her earlier comment that this was "not possible in my past schools because I couldn't find a board big enough to fit it all on" (Anna, Interview 6/9/12). While Anna indicated that she had the technological hardware that enabled her to overcome the physical limitation



imposed by smaller chalk or white boards, she also indicated that when using PowerPoint it was important to use technology in class as “nowadays students are born with technology, they need something more visual. I really enjoy using technology because it is faster for me to bring the ideas to the students”, “I can create more accurate graphs for students to look at” and “I want to do more [technologically based] things like Jake and John to improve the way we visualise [content] problems for students” (Anna, Interview 6/9/12).

Anna and Jake’s differing use of PowerPoint provides one example of the different ways in which they used digital technologies as part of their classroom practice while teaching the same content to the same students at the same time. Despite their mutual engagement in planning and delivering their shared classes, the differences evident in the way Anna and Jake enacted their TPACK, in particular their TPK, draws into question the effectiveness of previous descriptions of context as part of the TPACK framework (for example, see: Cox, 2008; Kelly, 2008; Koehler & Mishra, 2008) that only consider context as the location for the exhibition of knowledge or the physical factors that constrain or enable teachers’ practices. In contrast, the differences in Anna and Jake’s current and future TPACK enactment may be better explained by also incorporating considerations of identity and practice that consider ways in which their past participation (for example, making connections between TK and PK through Jake’s familial participation) helps shape current practices and future identities. Understanding context as both a location for the exhibition of knowledge as well as a series of socially mediated process that shape enactment addresses Hager’s (2005) criticism of workplace learning theories that rely on single factor or universally applicable explanations.

### *John's perspective*

John, Anna's other key professional learning colleague and the Deputy Head of Mathematics, commented on different strengths in Anna's professional knowledge claiming "her content knowledge is very, very good. And her technological knowledge is quite good now too" (John, Interview, 30/10/2012). However, when asked to indicate on the TPACK diagram where he believed Anna would be best represented he said "she is pushing towards the centre. It's difficult with pedagogical knowledge, because I haven't taught with her in a classroom ... but yeah towards the middle" (John, Interview, 30/10/2012) while marking the bottom right hand corner of the TPACK nexus as shown in Figure 3.

While a member of the Mathematics Teachers' CoP, John's professional relationship with Anna is different to her team teaching relationship with Jake. In contrast to Jake's perspective developed through a mutual engagement in classroom practice as a member of a teaching team, John relies upon an understanding of Anna's TPACK developed through emails, conversation, lesson plans and observation in professional development sessions "to [know] what kinds of activities she comes up with" (John, Interview, 30/10/2012). The ways in which John understands Anna's TPACK and the ways she enacts TPACK are somewhat removed from observations of classroom practice "because I haven't taught with her in a classroom" (John, Interview, 30/10/2012). John's understanding is developed through different forms of interaction compared to the way Anna interacts with Jake. John's abstraction from the classroom environment appears to limit his ability to make specific or accurate judgements about certain forms of knowledge, in this case Anna's PK. John's difficulty judging Anna's PK because he "hasn't taught with her in a classroom" (John, Interview, 30/10/2012) suggests that John feels as though he can't accurately comment on Anna's PK without

observing her enacting her knowledge (her practice). This may mean that TPACK studies that rely on abstracted understandings of knowledge (for example, see: Barab & Duffy, 2000; Barton & Tusting, 2005; Drath & Palus, 1994; Fuller, Hodkinson, Hodkinson, & Unwin, 2005; Gray, 2004; Handley, Sturdy, Fincham, & Clark, 2006; Hildreth, Kimble, & Wright, 1998), such as John's understanding of Anna's PK, without seeing the enactment of that knowledge may be less informed than those understandings developed through observation of the enactment of that knowledge such as Jake's understanding revealed earlier in this paper.

While providing an additional perspective of Anna's TPACK, John's comments also reinforce the importance of changes over time when considering in-service teachers TPACK. John's comments that Anna's TK is "quite good now *too* [emphasis added]" and "she is *pushing* towards the centre [emphasis added]" (John, Interview, 30/10/2012) indicate that from John's perspective, Anna's TK has developed from where it was at a previous point in time and that she is now closer to achieving TPACK than she may have been in the past. John's comments confirm that TPACK connects past participation with current competence and when considered in Anna's case with her desire to improve TK, future aspirations.

Figure 2 highlights a weakness with this representation of the TPACK framework; namely that the TPACK nexus is small compared to the six areas representing the other individual and overlapping forms of knowledge thereby making TPACK differentiation difficult. This difficulty is compounded when considering the way in which the overlapping circles representing technological, pedagogical and content knowledge are overlapped. In this case, this is evident in the location Anna chose as representative of her current TPACK. As illustrated in Figure 3, Anna's self-reported TPACK position was in the overlap between pedagogical and content

knowledge. While this position provides a general sense of Anna's belief about her relative TPACK strengths and weaknesses, this representation of her TPACK also indicates that she has no TK. While data presented in this paper indicates that Anna believes her TK is weaker than her PCK, it is very clear that Anna does have *some* TK. The challenge therefore, is to develop a representation of TPACK in which the individual forms of knowledge are overlapped in a different way that allows for a more nuanced representation of an individual's knowledge.

While the representation of TPACK used in this research presents some challenges, it is helpful to illustrate the relative position of Anna's TPACK indicated by each of the participants in this case. Figure 3 shows some differences in individual beliefs about Anna's TPACK, however the positions marked by Anna, Jake and John are not disparate suggesting that the TPACK model is useful as a method for broad identification. As such, general conclusions can be drawn from the identification of the location of Anna's TPACK by each of the participants in this case and the descriptions which accompanied them. In particular, one is able to surmise that:

- 1) Anna believes:
  - a) her PCK is stronger than her TK;
  - b) however, her TCK is stronger than her TPK;
  - c) that she aspires more TK to reach the TPACK nexus.
- 2) Jake believes:
  - a) Anna's TK, CK and PK are well balanced;
  - b) while Anna has strong TK, it is different to his own;
  - c) her knowledge is best located in the centre of the TPACK nexus;
- 3) John believes:
  - a) that Anna's TK and CK are high;

- b) with some reservation Anna has relatively strong PK;
- c) she is “pushing” towards and therefore may not have quite reached the aspirational TPACK nexus.

This summary serves to provide two reminders: First, TPACK may be judged from a communal perspective as well as from an individual’s perspective. Anna’s mutual engagement with John and Jake provides her key professional learning colleagues with an understanding of Anna’s practices and her identity. Second, this understanding Anna’s practices and identity draw on her past participation and her future aspirations suggesting TPACK is both knowledge used to support current practices but it is also knowledge in the making. Anna’s case shows how TPACK development is an ongoing process rather than as an acquired end point.

Anna’s imagined future trajectory in which she reinforces her identity as a competent classroom teacher by developing and enacting a stronger TK echoes Hager’s (2005) theoretical proposition of a (re)construction metaphor. Anna’s desired (re)construction of her TPACK, her practices and her identity helps to explain her mutual engagement and provides an additional example of how TPACK enactment is influenced in a CoP.

## **Conclusion**

Analysis of Anna’s case highlighted the importance of the theoretical connection between identity, practice and knowledge enactment (behaviour) from a CoP perspective. In Anna’s case, the connection between identity, practice and her TPACK enactment was revealed through her imagined future trajectory as a classroom teacher and her consequent TK development through her near-peer relationships with Jake. In particular, the connection between identity and practice exemplified in Anna’s case

adds to previous TPACK descriptions that characterised context as the location for the exhibition of knowledge by broadening out our understanding of context and through a set of socially-mediated practices.

This finding has theoretical implications for the TPACK framework as it changes the way the interplay between technological, pedagogical and content knowledge unfolds: first, context can be thought of as a series of processes grouped around practice and identity and these help to explain how TPACK development and enactment occurs in a workplace. Second, changes in TPACK can be considered as changes that occur in context, that is, TPACK may not change within an individual but the context in which it is situated may shape the way it is enacted among individuals. Third, Anna's case reveals that TPACK can be thought of as an aspect of trajectory that connects an individual's past participation in a CoP with his or her current competence and anticipated future competence.

The primacy of context, as seen in these three findings, broadens what comprises context to include practice and identity. It also unsettles assumptions of previous TPACK investigations that have attempted to measure current TPACK levels and retrospective changes in TPACK without considering the socially mediated context in which TPACK is enacted.

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